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Masayuki et. al.

TITLE: Chemical-mechanical polish aqueous dispersion for micronized element separation in semiconductor manufacture, contains inorganic particle and surfactant containing nitrogen

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ABSTRACTED-PUB-NO: JP2002190458A

BASIC-ABSTRACT:

NOVELTY - A chemical-mechanical polish aqueous dispersion contains inorganic particle and nitrogen containing surfactant.

USE - For micronized element separation such as shallow trench isolation process, in production of semiconductor device (claimed).

ADVANTAGE - The excessive polishing of insulator film is prevented by using the chemical-mechanical polish aqueous dispersion. Generation of scratch and flaws on surface of insulator material surface is prevented.

DESCRIPTION OF DRAWING(S) - The figure shows the ground material before polishing during chemical-mechanical sanding of shallow trench isolation process.

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(71) Applicant: JSR CORP

(72) Inventor: HATTORI MASAYUKI
ANDO MICHIAKI
KAWAHASHI NOBUO

(54) WATER DISPERSION FOR CHEMICAL MECHANICAL POLISHING

(57) Abstract:

PROBLEM TO BE SOLVED: To provide a water dispersion for chemical mechanical polishing, used for an STI step having mall excessive polishing (dishing) of an insulator film and low occurrence of scratches (surface damages of an insulator material, after polishing).

SOLUTION: The water dispersion for chemical mechanical polishing comprises inorganic particles, and nitrogen atom-containing surfactants.

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(71)出願人　000004178
ジェイエスアール株式会社
東京都中央区築地２丁目11番24号

(72)発明者　服部　雅幸
東京都中央区築地二丁目11番24号　ジェイエスアール株式会社内

(72)発明者　安藤　民智明
東京都中央区築地二丁目11番24号　ジェイエスアール株式会社内

(72)発明者　川橋　信夫
東京都中央区築地二丁目11番24号　ジェイエスアール株式会社内

最終頁に続く

(54)【発明の名称】　化学機械研磨用水系分散体

(57)【要約】
【課題】　絶縁体膜の過剰研磨（ディッシング）が小さく、かつ、スクラッチ（研磨後の絶縁体材料表面の傷）の発生が少ない、ＳＴＩ工程に用いる化学機械研磨用水系分散体を提供すること。
【解決手段】　上記課題は、無機粒子と、窒素原子含有界面活性剤を含有することを特徴とする、化学機械研磨用水系分散体によって解決される。

【特許請求の範囲】
【請求項１】　無機粒子と、窒素原子含有界面活性剤を含有することを特徴とする、化学機械研磨用水系分散体。
【請求項２】　無機粒子が、ヒュームド法シリカまたはコロイダルシリカである請求項１に記載の化学機械研磨用水系分散体。
【請求項３】　無機粒子が、セリアである請求項１に記載の化学機械研磨用水系分散体。
【請求項４】　半導体の製造における微細化素子分離工程に用いられる請求項１～３のいずれか一項に記載の化学機械研磨用水系分散体。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、化学機械研磨用水系分散体に関する。更に詳しくは、半導体装置の製造工程における微細化素子分離工程に用いられる化学機械研磨用水系分散体に関する。
【０００２】
【従来の技術】半導体装置の集積度の向上、多層配線化などにともない、メモリデバイスの記憶容量は飛躍的に増大している。これは、加工技術の微細化の進歩に支えられたものである。しかし要求される記憶容量は年々大きくなり、多層配線化等の技術を駆使しても、チップサイズの増大は避けられず、また、微細化にともないメモリデバイス製造に要する工程数は増え、チップのコスト高を招いている。このような状況下、被加工膜等の研磨に化学機械研磨の技術が導入され、注目を集めている。この化学機械研磨の技術を適用することにより、より効率的に微細構造の高容量メモリデバイスの製造が可能になりつつある。
【０００３】そのような技術のひとつとして、さらなる微細化を目的として、例えば、微細化素子分離（Ｓｈａｌｌｏｗ　Ｔｒｅｎｃｈ　Ｉｓｏｌａｔｉｏｎ）、いわゆる、ＳＴＩ技術が検討されている。このＳＴＩ技術は、シリコン基板に溝を形成した後、絶縁膜材料を堆積し、化学機械研磨により余剰の絶縁膜を除去するものであり、従来の化学機械研磨に比較してより微細な配線構造を形成することができる。しかし、従来知られていた化学機械研磨とは主たる研磨対象を異にするため、従来用いられていた化学機械研磨用分散体をそのまま使用すると、工程上、種々の問題が生ずる。特に、絶縁体膜の過剰研磨（ディッシング）が大きくなり、スクラッチ（研磨後の絶縁体材料表面の傷）が発生しやすく、半導体製造の歩留まりの向上に対して障害となっていた。
【０００４】
【発明が解決しようとする課題】本発明は、上記の状況に鑑み、絶縁体膜の過剰研磨（ディッシング）が小さく、かつ、スクラッチ（研磨後の絶縁体材料表面の傷）の発生が少ない、即ち平坦化特性の優れた、ＳＴＩ工程に用いる化学機械研磨用水系分散体を提供することを目的とする。
【０００５】
【課題を解決するための手段】本発明によれば、上記課題は、無機粒子と、窒素原子含有界面活性剤を含有することを特徴とする、化学機械研磨用水系分散体によって解決される。以下に本発明の化学機械研磨用水系分散体について詳細に説明する。本発明の化学機械研磨用水系分散体は、無機粒子と、窒素原子含有界面活性剤を含有する
【０００６】上記「無機粒子」としては、その目的に応じて適宜のものが使用できるが、例えばシリカ、セリア、アルミナ、チタニア、ジルコニア等が好ましいものとして挙げられる。これらのうち、シリカ、およびセリアが特に好ましい。シリカとしては、①塩化ケイ素等を水素と酸素の存在下に気相において反応させて得られるヒュームド法シリカ、②ケイ酸塩をイオン交換して得られるコロイダルシリカ、及び③金属アルコキシドから加水分解及び縮合を経て得られるコロイダルシリカ等が挙げられる。また、セリアとしては、炭酸セリウム、水酸化セリウム、或いはシュウ酸セリウム等を焼成してなるものを用いることができ、これらのうち、炭酸セリウムを焼成して得られるセリアが特に好ましい。無機粒子は１種のみを使用してもよいが、シリカとセリア、シリカとアルミナ、或いはセリアとアルミナ等、２種以上を組み合わせて用いることもできる。また有機粒子を上記無機粒子と組み合わせて使用することもできる。
【０００７】上記「有機粒子」としては、ポリ塩化ビニル、ポリスチレン及びスチレン系共重合体、ポリアセタール、飽和ポリエステル、ポリアミド、ポリカーボネート、ポリエチレン、ポリプロピレン、ポリ－１－ブテン、ポリ－４－メチル－１－ペンテン等のポリオレフィン及びオレフィン系共重合体、フェノキシ樹脂、ポリメチルメタクリレート等の（メタ）アクリル樹脂及び（メタ）アクリル系共重合体などの熱可塑性樹脂が挙げられる。
【０００８】また、スチレン、メチルメタクリレート等と、ジビニルベンゼン、エチレングリコールジメタクリレート等とを共重合させて得られる架橋構造を有する共重合樹脂が挙げられる。更に、フェノール樹脂、尿素樹脂、メラミン樹脂、エポキシ樹脂、アルキッド樹脂及び不飽和ポリエステル樹脂等の熱硬化性樹脂が挙げられる。これらの有機粒子は、乳化重合法、懸濁重合法、乳化分散法、粉砕法等、各種の方法により製造することができる。尚、これらの有機粒子は１種のみを使用でも良いし、２種以上を併用することもできる。
【０００９】更に、無機粒子と有機粒子とは、必ずしも各々が独立した状態で分散している必要はない。例えば、無機粒子と有機粒子とが混在する状態でアルコキシシランを重縮合させ、有機粒子の少なくとも表面にポリ

シロキサン等が結合され、更にシリカ、セリア等の無機粒子が静電力等により結合された形態等であってもよい。尚、生成するポリシロキサン等は有機粒子が有するアニオン基に直接結合されていてもよいし、シランカップリング剤等を介して間接的に結合されていてもよい。

【００１０】無機粒子の平均粒子径（平均二次粒径）は０．０１～３μｍであることが好ましく、この平均粒子径が０．０１μｍ未満であると、十分に研磨速度の大きい水系分散体とすることができない。一方、平均粒子径が３μｍを超える場合は、無機粒子が沈降し、分離し易くなり、安定な水系分散体とすることが容易ではない。この平均粒子径は、特に０．０２～１．０μｍ、更には０．０３～０．７μｍであることが好ましい。この範囲の平均粒子径を有する無機粒子であれば、研磨速度が大きく、且つ粒子の沈降、分離も抑えられ、安定な化学機械研磨用水系分散体とすることができる。尚、この平均粒子径は、動的光散乱法測定機、レーザー散乱回折型測定機等により測定することができ、透過型電子顕微鏡による観察によって計測することもできる。また、乾燥し、粉体化した無機粒子の比表面積を測定し、それに基づいて算出することもできる。

【００１１】有機粒子の平均粒子径は０．０１～３μｍであることが好ましい。この平均粒子径が０．０１μｍ未満であると、酸化ケイ素膜を研磨する速度の、窒化ケイ素膜を研磨する速度に対する比が小さく、選択性が十分に向上しないことがある。一方、平均粒子径が３μｍを超える場合は、有機粒子が沈降し、分離し易く、安定な水系分散体とすることが容易ではない。この平均粒子径は、特に０．０２～１．０μｍ、更には０．０４～０．７μｍであることが好ましい。この範囲の平均粒子径を有する有機粒子であれば、平坦化特性に優れ、かつ粒子が沈降しても固い沈降層ができないため再分散性に優れ、安定な化学機械研磨用水系分散体とすることができる。尚、この平均粒子径は無機粒子の場合と同様にして測定することができる。

【００１２】水系分散体における無機粒子の含有量は、無機粒子の種類にもよるが、シリカの場合は、水系分散体を１００質量部（以下、「部」と略記する。）とした場合に、２～２０部とすることができ、特に４～１５部、更には６～１２部とすることが好ましい。シリカの含有量が２部未満であると、研磨速度が十分に向上せず、２０部を超える場合は、水系分散体の安定性が低下する傾向にあり、コスト高にもなるため好ましくない。また、セリアの場合は、水系分散体を１００部とした場合に、０．０２～５部とすることができ、特に０．０５～２部、更には０．１～１部とすることが好ましい。セリアの含有量が下限値未満、或いは上限値を超える場合は、シリカと同様の問題を生ずるため好ましくない。

【００１３】本発明において使用される窒素原子含有界面活性剤としては、例えば、塩化ラウリルトリメチルアンモニウム、塩化セチルトリメチルアンモニウム、塩化ステアリルトリメチルアンモニウム、塩化ジステアリルジメチルアンモニウム、炭素数１２～１８のアルキル基を含有する塩化ジアルキルジメチルアンモニウム、アルキルイミダゾリン、塩化ベンザルコニウム液などの陽イオン界面活性剤；ラウリルジメチルアミノ酢酸ベタイン、ステアリルジメチルアミノ酢酸ベタイン、ラウリルジメチルアミンオキサイド、２－アルキル－Ｎ－カルボキシメチル－Ｎ－ヒドロキシエチルイミダゾリニウムベタイン、ラウリン酸アミドプロピルベタイン、ヤシ酸アミドプロピルベタイン、ラウリルヒドロキシスルホベタインなどの両性界面活性剤；ポリオキシエチレンアルキルアミン、パーム核油脂肪酸ジエタノールアミド、およびラウリン酸ジエタノールアミドなどのアルキルアルカノールアミド型のノニオン性界面活性剤等を例示することができる。これらのうち、陽イオン界面活性剤、およびノニオン性界面活性剤が好ましく、塩化ラウリルトリメチルアンモニウム、ポリオキシエチレンアルキルアミン、およびラウリン酸ジエタノールアミドが特に好ましい。

【００１４】水系分散体における、窒素原子含有界面活性剤の含有量は、種類にもよるが、水分散体１００部とした場合に０．０００１～１部とすることができ、更に好ましくは０．００１～０．１部とすることが好ましい。窒素原子含有界面活性剤の含有量が０．０００１部未満では目的とする平坦化が達成できず、含有量が１部を越えると、研磨速度が著しく低下する場合があるため好ましくない。

【００１５】水系分散体の媒体としては、水、及び水とメタノール等、水を主成分とする混合媒体を使用することができるが、水のみを用いることが好ましい。

【００１６】本発明の水系分散体には種々の添加剤を配合し、その性能を更に向上させることができる。酸を含有させることによって、水系分散体を安定させることができ、選択性を向上させることができる場合もある。この酸は特に限定されず、有機酸、無機酸のいずれも使用することができる。有機酸としては、パラトルエンスルホン酸、ドデシルベンゼンスルホン酸、イソプレンスルホン酸、グルコン酸、乳酸、クエン酸、酒石酸、リンゴ酸、グリコール酸、マロン酸、ギ酸、シュウ酸、コハク酸、フマル酸、マレイン酸及びフタル酸等が挙げられる。また、無機酸としては、硝酸、塩酸及び硫酸等が挙げられる。これら有機酸及び無機酸は各々１種のみを用いてもよいし、２種以上を併用することもでき、有機酸と無機酸とを併用することもできる。これらの酸は、水系分散体を１００部とした場合に、０．０２～２部、特に０．０５～１部含有させることができる。

【００１７】水系分散体に更に塩基を含有させ、ｐＨを調整することによって、粒子の分散性、研磨速度等をより向上させることができる。この塩基は特に限定され

ず、有機塩基、無機塩基のいずれも使用することができる。有機塩基としては、エチレンジアミン、エタノールアミン等の窒素含有有機化合物などが挙げられる。更に、無機塩基としては、アンモニア、水酸化カリウム、水酸化ナトリウム、水酸化リチウム等が挙げられ、これらの塩は１種のみを用いてもよいし、２種以上を併用することもできる。塩基の含有量はｐＨを調整するうえで重要であるが、水系分散体を１００部とした場合に、０．０１～１部、特に０．０２～０．５部含有させることができる。

【００１８】好ましいｐＨは無機粒子により異なり、シリカの場合はｐＨは１０～１２、セリアの場合はｐＨ５～１２であることが好ましく、このｐＨ範囲であれば研磨速度及び平坦化度がともに向上するため好ましい。

【００１９】水系分散体には、その他の添加剤として、過酸化水素、過硫酸塩、ヘテロポリ酸等の酸化剤、或いはアルミニウム、チタン、バナジウム、クロム、鉄等の多価金属イオンなどを含有させることもできる。更に、ドデシルベンゼンスルホン酸カリウム、ドデシル硫酸アンモニウム等の界面活性剤、高分子量のポリアクリル酸等の分散剤、及びポリアクリルアミド等の粘度調整剤などを含有させることもできる。

【００２０】本発明の化学機械研磨用水系分散体は、上記のように無機粒子と、窒素原子含有界面活性剤と必要に応じて上記の各種の添加剤を組み合わせ、含有させることにより、半導体装置の製造におけるＳＴＩ工程において用いることができ、絶縁体膜の過剰研磨（ディッシング）が少なく、スクラッチ（研磨後の絶縁体材料表面の傷）が発生が少ない、平坦化性能の優れた研磨剤とすることができる。

【００２１】本発明の化学機械研磨用水系分散体を用いて、被研磨面を化学機械研磨する場合は、市販の化学機械研磨装置（株式会社荏原製作所製、型式「ＥＰＯ－１１２」、「ＥＰＯ－２２２」等、ラップマスターＳＦＴ社製、型式「ＬＧＰ－５１０」、「ＬＧＰ－５５２」等、アプライドマテリアル社製、品名「Ｍｉｒｒａ」、ラム・リサーチ社製、品名「Ｔｅｒｅｓ」、Ｓｐｅｅｄ Ｆａｍ－ＩＰＥＣ社製、型式「ＡＶＡＮＴＩ ４７２」等）を用いて研磨することができる。研磨条件は目的の応じて適宜の条件を採用することができるが、たとえば以下の条件とすることができる。

水系分散体供給量；１００～３００ｍＬ／分

研磨荷重；２００～６００ｇ／ｃｍ^2

定盤回転数；５０～１００ｒｐｍ

ヘッド回転数；５０～１００ｒｐｍ

【００２２】本発明の化学機械研磨用水系分散体は、無機粒子としてシリカを含有する場合、ＳＴＩ工程において例えば図１のような幅２５０μｍの溝を形成したシリコン基板上に、絶縁体材料を厚さｔだけ堆積させたときの初期段差Ｔ$_0$が４００ｎｍ以上、例えば９００ｎｍである被研磨体を、図２の状態まで１５％オーバーポリッシュしたときのディッシングＴが、９０ｎｍ以下である。ここで、「１５％オーバーポリッシュ」とは、絶縁体材料の堆積厚さｔを研磨速度で除したジャストの研磨時間に対し、１５％だけ余分な時間研磨を継続することをいう。

【００２３】また、無機粒子としてセリアを含有する本発明の化学機械研磨用水系分散体は、上記と同様の条件で評価したときのディッシングＴは、８０ｎｍ以下であり、さらに窒素原子含有界面活性剤の使用量を調整することにより７０ｎｍ以下、６０ｎｍ以下とすることもできる。なお、従来知られている化学機械研磨用水系分散体を使用して上記と同様の条件で評価すると、ディッシングＴの値は１００～２００ｎｍ程度である。

【００２４】本発明の化学機械研磨用水系分散体は、研磨後の絶縁体材料表面にスクラッチが発生することが少なく、例えば、８インチの熱酸化膜ウェハを２分間研磨したときの、最大長さ１μｍ以上のスクラッチの発生が、ウェハ当たり５個以下とすることができ、さらには窒素原子含有界面活性剤の使用量を調整することにより３個以下、０個とすることもできる。

【００２５】

【発明の実施の形態】以下に、実施例により本発明をさらに詳しく説明する。

【００２６】無機粒子としてシリカを含有する水系分散体

実施例１

①水系分散体の調製

ヒュームド法シリカ（日本アエロジル（株）製、商品名「＃９０アエロジル」、平均一次粒径２０ｎｍ、平均二次粒径２２０ｎｍ）を１０質量％、ＫＯＨを０．２質量％の含有量となるように配合した水分散体に、窒素原子含有界面活性剤として塩化ラウリルトリメチルアンモニウムを０．００１重量％配合し水系分散体を調製した。このときのｐＨは、１０．４であった。

【００２７】②ディッシングの評価

ＴＥＯＳ膜付きの、パターン付きウェーハＳＫＷ－７（商品名、ＳＫＷ社製、ライン幅２５０μｍ、絶縁体材料の積層膜厚２０００ｎｍ、初期段差９００ｎｍ）を下記条件にて研磨した。

化学機械研磨装置；ＥＰＯ１１２（（株）荏原製作所製）

研磨パッド；ＩＣ１０００／ＳＵＢＡ４００（ロデールニッタ社製）

水系分散体供給量；２００ｍＬ／分

研磨荷重；４００ｇ／ｃｍ^2

定盤回転数；７０ｒｐｍ

ヘッド回転数；７０ｒｐｍ

研磨時間；１５％オーバー（（絶縁体材料の積層膜厚／研磨速度）×１．１５）

【００２８】研磨後のディッシングを、微細形状測定装置（ＫＬＡ-Ｔｅｎｃｏｒ社製、形式「Ｐ－１０」）を用いて測定した。その結果ディッシングは６０ｎｍであり、極めて良好であった。なお、ディッシングの値の評価基準は以下の通りである。

１００ｎｍ以上：不良

９０ｎｍ以下：良好

７０ｎｍ以下：極めて良好

【００２９】③スクラッチの評価

８インチ熱酸化膜ウェハ（ＡＭＴ社製製）を、研磨時間を２分間とした他は②と同様の条件で研磨した後、パターンなしウェーハ表面異物検査装置（ケーエルエー・テンコール社製、型式「サーフスキャン６４２０」）により測定した。その結果、スクラッチは全く検出されなかった。

【００３０】上記の評価結果から、この水系分散体はＳＴＩ工程に用いる水系分散体として極めて良好な性能を有する水系分散体であることが分かった。

【００３１】実施例２～７、および比較例１～４

シリカの種類、窒素原子含有界面活性剤の種類、その他の添加剤の種類を表１のようにし、実施例１と同様にディッシングおよびスクラッチの評価を実施した。結果は、表１に示す。なお、コロイダルシリカは、Ｊ．ｏｆ Ｃｏｌｌｏｉｄ ａｎｄ Ｉｎｔｅｒｆａｃｅ Ｓｃｉｅｎｃｅ ２５，６２－６９（１９６８）に記載されているように、エタノールおよび水を媒体として、テトラエトキシシランを、アンモニア触媒存在下に縮合させた後、水に溶媒置換させたものを使用した。ここで、エタノールと水の組成比を調整することにより、平均一次粒径１５ｎｍ（平均二次粒径３９ｎｍ）および平均一次粒径３５ｎｍ（平均二次粒径６７ｎｍ）の２種類のコロイダルシリカを調製した。。また、表１において、その他添加剤として加えた「ＤＢＳ－Ｋ」はドデシルベンゼンスルホン酸カリウムを表し、「ＰＡＡ－Ｋ」はポリアクリル酸カリウム塩（分子量；６０００）を表す。

【００３２】

【表１】

	無機粒子 種類	無機粒子 濃度(%)	窒素原子含有界面活性剤 種類	窒素原子含有界面活性剤 濃度(%)	その他添加剤 種類：濃度	pH調整剤 種類：濃度	pH	研磨速度 (nm/min)	ディッシング (nm)	スクラッチ (個/Wafer)
実施例１	#90コロイダル 20nm	10	塩化ラウリルトリメチルアンモニウム	0.001	－	KOH：0.2%	10.4	180	60	0
実施例２	#90コロイダル 20nm	10	塩化ラウリルトリメチルアンモニウム	0.01	－	KOH：0.2%	10.4	120	40	0
実施例３	#90コロイダル 20nm	10	ドデシルトリメチルアンモニウム	0.001	－	KOH：0.2%	10.5	201	65	0
実施例４	#90コロイダル 20nm	10	ドデシルトリメチルアンモニウム	0.01	－	KOH：0.2%	10.6	153	43	0
実施例５	コロイダルシリカ 35nm	12	塩化ラウリルトリメチルアンモニウム	0.001	－	KOH：0.2%	10.2	143	54	0
実施例６	コロイダルシリカ 35nm	12	ドデシルトリメチルアンモニウム	0.001	－	KOH：0.2%	10.8	163	62	0
実施例７	コロイダルシリカ 15nm	12	ラウリルアミノエチルグリシン	0.01	－	KOH：0.2%	10.8	181	43	0
比較例１	#90コロイダル 20nm	10	無添加	0	－	KOH：0.2%	10.7	210	159	3
比較例２	#90コロイダル 20nm	10	無添加	0	DBS-K：0.1%	KOH：0.2%	10.5	54	95	5
比較例３	#90コロイダル 20nm	10	無添加	0	PAA-K：0.1%	KOH：0.2%	10.5	29	81	10
比較例４	コロイダルシリカ 35nm	12	無添加	0	－	KOH：0.2%	10.4	185	152	1

【００３３】表１によれば、実施例１～７では、研磨速度は１２０ｎｍ／分以上と十分であるとともに、ディッシングは７０ｎｍ以下であり、また、スクラッチもまったく検出されておらず、これらの水系分散体はＳＴＩ工程における水系分散体として極めて優良であることが分かる。一方、比較例１、４ではディッシングの値が１１５および１２２と大きく、このような水系分散体は、ＳＴＩ工程における水系分散体としては使用することができない。また、比較例２、３では研磨速度が小さく、これらの水系分散体は実用に供し得ないものであることが分かる。

【００３４】無機粒子としてセリアを含有する水系分散体

実施例８

①セリアの調製

バストネサイトを原料とし、これを硝酸に溶解させた

後、炭酸塩として再結晶を３回繰り返し、高純度化されたセリウムの炭酸塩を得た。これを９００℃で５時間焼成しセリアを得た。このセリアを硝酸の存在下でイオン交換水に０．３質量%の含有量となるように分散させ、ｐＨを６に調整して、平均粒子径（二次粒子径）０．２４μｍのセリアを含有する水分散体を得た。次いで、ポリオキシシチレンアルキルアミンを０．０３重量%となる濃度で添加し、セリアを含有する水系分散体を調製した。

【００３５】②ディッシングの評価

上記で調製した水系分散体を使用し、実施例１と同様にしてディッシングの評価を行った。その結果ディッシングは６０ｎｍと極めて良好であった。

【００３６】③スクラッチの評価

上記で調製した水系分散体を使用し、実施例１と同様にしてスクラッチの評価を行った。その結果、スクラッチは検出されなかった。

【００３７】上記の評価結果から、この水系分散体はＳＴＩ工程に用いる水系分散体として極めて良好な性能を有する水系分散体であることが分かった。

【００３８】実施例９～１６、および比較例５～１０窒素原子含有界面活性剤の種類と添加量、その他の添加剤の種類と添加量を表２のようにした他は、実施例８と同様にしてディッシングおよびスクラッチの評価を実施した。結果は、表２に示す。なお、表２におけるその他の添加剤のＤＢＳ－Ｋ、およびＰＡＡ－Ｋは、表１と同じであり、「ＩＰＳ－Ｋ」はポリイソプレンスルホン酸カリウム塩（分子量；８０００）を表す。

【００３９】

【表２】

	砥粒粒子		窒素原子含有界面活性剤		その他添加剤	pH調整剤	pH	研磨速度	ディッシング	スクラッチ
	種類	濃度(%)	種類	濃度(%)	種類；濃度	種類；濃度		(nm/min)	(nm)	(個/ウェハ)
実施例８	0.24μm酸化セリウム	0.3	ポリオキシエチレンアルキルアミン	0.001	—	KOH；0.04%	6.0	290	50	0
実施例９	0.24μm酸化セリウム	0.3	ポリオキシエチレンアルキルアミン	0.01	—	KOH；0.04%	6.5	210	30	0
実施例１０	0.24μm酸化セリウム	0.3	塩化ラウリルトリメチルアンモニウム	0.001	—	KOH；0.04%	6.0	230	59	0
実施例１１	0.24μm酸化セリウム	0.3	塩化ラウリルトリメチルアンモニウム	0.01	—	KOH；0.04%	6.2	181	35	0
実施例１２	0.24μm酸化セリウム	0.3	ラウリルジメチルアミノ酢酸ベタイン	0.01	—	KOH；0.04%	6.5	143	55	0
実施例１３	0.24μm酸化セリウム	0.3	ポリオキシエチレンアルキルアミン	0.01	—	KOH；0.04%	6.9	163	63	0
実施例１４	0.24μm酸化セリウム	0.3	ラウリン酸ジエタノールアミド	0.01	—	KOH；0.04%	7.1	181	49	0
比較例５	0.24μm酸化セリウム	0.3	無添加	0	—	KOH；0.04%	6.0	410	210	12
比較例６	0.24μm酸化セリウム	0.3	無添加	0	DBS K;0.1%	KOH；0.04%	6.5	290	120	6
比較例７	0.24μm酸化セリウム	0.3	無添加	0	PAA-K;0.1%	KOH；0.04%	6.7	94	105	12
比較例８	0.24μm酸化セリウム	0.3	無添加	0	IPS-K;0.1%	KOH；0.04%	6.8	210	115	2

【００４０】表２によれば、実施例８～１４では、研磨速度は１４０ｎｍ／分以上と十分に大きいとともに、ディッシングは７０ｎｍ以下であり、スクラッチも観察されておらず、これらの水系分散体はＳＴＩ工程における水系分散体として極めて優良であることが分かる。一方、比較例５～８では、ディッシングが１００ｎｍ以上と大きく、且つスクラッチも多く、これらの水系分散体は、ＳＴＩ用として使用することは困難であることが分かる。

【００４１】

【発明の効果】本発明によれば、絶縁体膜の過剰研磨（ディッシング）が小さく、かつ、スクラッチ（研磨後の絶縁体材料表面の傷）の発生が少なく、ＳＴＩ工程に用いる化学機械研磨用水系分散体として極めて好適な水系分散体が提供される。

【００４２】

【図面の簡単な説明】

【図１】ＳＴＩ工程の化学機械研磨における被研磨物の研磨前の状態を示す模式図である。

【図２】ＳＴＩ工程の化学機械研磨における被研磨物の研磨後の状態を示す模式図である。

【符号の説明】

１　シリコン基板

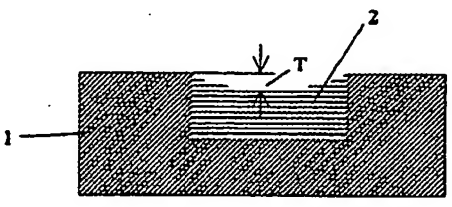
２　絶縁体材料

ｔ　絶縁体材料の初期堆積厚さ

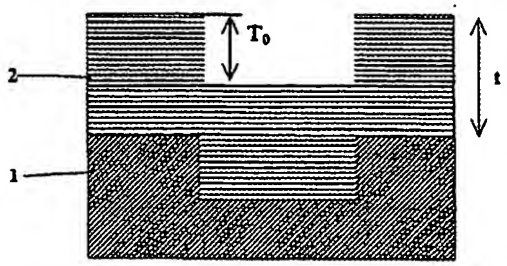
Ｔ０　初期段差

Ｔ　ディッシング

【図２】



【図１】



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GG05 GG10

* NOTICES *

JP2002-190458

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CLAIMS

[Claim(s)]
[Claim 1] An inorganic particle and the chemical machinery polish water-system dispersing element characterized by containing a nitrogen atom content surfactant.
[Claim 2] The chemical machinery polish water-system dispersing element according to claim 1 whose inorganic particle is a fumed ** silica or colloidal silica.
[Claim 3] The chemical machinery polish water-system dispersing element according to claim 1 whose inorganic particle is Seria.
[Claim 4] A chemical machinery polish water-system dispersing element given in any 1 term of claims 1-3 used for the detailed-ized isolation process in manufacture of a semi-conductor.

[Translation done.]

* NOTICES *

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a chemical machinery polish water-system dispersing element. Furthermore, it is related with the chemical machinery polish water-system dispersing element used for the detailed-ized isolation process in the production process of a semiconductor device in detail.

[0002]
[Description of the Prior Art] The storage capacity of a memory device is increasing by leaps and bounds with improvement in the degree of integration of a semiconductor device, multilayer-interconnection-izing, etc. This is supported to the advance of detailed-izing of a processing technique. However, even if the memory capacity demanded becomes large every year and it makes full use of techniques, such as multilayer-interconnection-izing, the routing counter which buildup of a chip size is not avoided and memory device manufacture takes with detailed-izing increased, and has caused the cost high of a chip. The technique of chemical machinery polish is introduced into polish of the processed film etc. under such a situation, and attention is attracted. By applying the technique of this chemical machinery polish, manufacture of the high capacity memory device of the fine structure is being attained more efficiently.
[0003] As one of such the techniques, detailed-ized isolation (Shallow Trench Isolation) and the so-called STI technique are examined for the purpose of the further detailed-izing. After this STI technique forms a slot in a silicon substrate, it can deposit an insulator layer ingredient, can remove an excessive insulator layer by chemical machinery polish, and can form more detailed wiring structure as compared with the conventional chemical machinery polish. However, with the chemical machinery polish known conventionally, since it differs in the main object for polish, if the dispersing element for chemical machinery polish used conventionally is used as it is, various problems will arise on a process. Especially, superfluous polish (dishing) of the insulator film became large, and it was easy to generate a scratch (blemish of the insulator material-list side after polish), and had become a failure to improvement in the yield of semi-conductor manufacture.
[0004]
[Problem(s) to be Solved by the Invention] This invention aims at superfluous polish (dishing) of the insulator film being small, and there being little generating of a scratch (blemish of the insulator material-list side after polish), namely, offering the chemical machinery polish water-system dispersing element which was excellent in the flattening property and which is used for a STI process in view of the above-mentioned situation.
[0005]
[Means for Solving the Problem] According to this invention, the above-mentioned technical problem is solved by an inorganic particle and the chemical machinery polish water-system dispersing element characterized by containing a nitrogen atom content surfactant. The chemical machinery polish water-system dispersing element of this invention is explained below at a detail. The chemical machinery

polish water-system dispersing element of this invention is an inorganic particle and [0006] containing a nitrogen atom content surfactant. Although a proper thing can be used as the above "an inorganic particle" according to the object, a silica, Seria, an alumina, a titania, a zirconia, etc. are mentioned as a desirable thing, for example. A silica and especially Seria are [among these] desirable. The colloidal silica pass hydrolysis and condensation from the fumed ** silica which ** silicon chloride etc. is made to react to the bottom of existence of hydrogen and oxygen in a gaseous phase as a silica, and is obtained, the colloidal silica obtained by carrying out the ion exchange of the ** silicate, and ** metal alkoxide is mentioned. Moreover, as Seria, the thing which comes to calcinate a carbonic acid cerium, a hydroxylation cerium, or a cerium oxalate can be used, and especially Seria that calcinates a carbonic acid cerium and is obtained is [among these] desirable. Although an inorganic particle may use only one sort, a silica, Seria and a silica, an alumina, Seria, an alumina, etc. can also be used combining two or more sorts. Moreover, an organic particle can also be used combining the above-mentioned inorganic particle.

[0007] As the above "an organic particle", thermoplastics, such as acrylic resin (meta), such as polyolefines, such as a polyvinyl chloride, polystyrene and a styrene system copolymer, polyacetal, saturated polyester, a polyamide, a polycarbonate, polyethylene, polypropylene, poly1 butene, and poly4 methyl 1 pentene, and an olefin system copolymer, phenoxy resin, and polymethylmethacrylate, and (meta) an acrylic copolymer, is mentioned.

[0008] Moreover, the copolymerization resin which has the structure of cross linkage which is made to carry out copolymerization of styrene, methyl methacrylate, etc. a divinylbenzene, ethylene glycol dimethacrylate, etc., and is obtained is mentioned. Furthermore, thermosetting resin, such as phenol resin, a urea-resin, melamine resin, an epoxy resin, an alkyd resin, and an unsaturated polyester resin, is mentioned. These organic particles can be manufactured by various kinds of approaches, such as an emulsion-polymerization method, a suspension-polymerization method, an emulsification variational method, and the grinding method. In addition, an activity is sufficient as these organic particles only in one sort, and they can also use two or more sorts together.

[0009] Furthermore, after each has become independent, it is not necessarily necessary to distribute the inorganic particle and the organic particle. For example, the polycondensation of the alkoxysilane may be carried out in the condition that an inorganic particle and an organic particle are intermingled, and you may be the gestalt of an organic particle with which the polysiloxane etc. was combined with the front face at least, and inorganic particles, such as a silica and Seria, were further combined by electrostatic force etc. In addition, direct coupling of the polysiloxane to generate may be carried out to the anion radical which an organic particle has, and it may be indirectly combined through the silane coupling agent etc.

[0010] That it is 0.01-3 micrometers cannot make mean particle diameter (second [an average of] particle size) of an inorganic particle a drainage system dispersing element with a fully large polish rate to it being desirable and this mean particle diameter being less than 0.01 micrometers. It is not easy for an inorganic particle to sediment, to become easy to dissociate and to consider as a stable drainage system dispersing element on the other hand, when mean particle diameter exceeds 3 micrometers. As for especially this mean particle diameter, it is desirable that they are 0.02-1.0 micrometers and further 0.03-0.7 micrometers. If it is the inorganic particle which has the mean particle diameter of this range, it is large, and sedimentation of a particle and separation are also suppressed, and a polish rate can consider as a stable chemical machinery polish water-system dispersing element. In addition, this mean particle diameter can be measured with a dynamic-light-scattering measurement machine, a laser dispersion diffraction mold measurement machine, etc., and can also be measured by observation by the transmission electron microscope. Moreover, it can dry, the specific surface area of the fine-particles-ized inorganic particle can be measured, and it can also compute based on it.

[0011] As for the mean particle diameter of an organic particle, it is desirable that it is 0.01-3 micrometers. If this mean particle diameter is less than 0.01 micrometers, the ratio to the rate which grinds the silicon nitride film of the rate which grinds the silicon oxide film may be small, and selectivity may not fully improve. It is not easy for an organic particle to sediment, to be easy to

dissociate and to consider as a stable drainage system dispersing element on the other hand, when mean particle diameter exceeds 3 micrometers. As for especially this mean particle diameter, it is desirable that they are 0.02-1.0 micrometers and further 0.04-0.7 micrometers. If it is the organic particle which has the mean particle diameter of this range, it excels in a flattening property, and since a hard sedimentation layer is not made even if a particle sediments, it excels in redispersible, and can consider as a stable chemical machinery polish water-system dispersing element. In addition, this mean particle diameter can be measured like the case of an inorganic particle.

[0012] Although the content of the inorganic particle in a drainage system dispersing element is based also on the class of inorganic particle, when a drainage system dispersing element is made into the 100 mass sections (it is hereafter written as the "section".), in the case of a silica, it is desirable to be able to consider as the two to 20 section and to consider as the four to 15 section and the further six to 12 section especially. When a polish rate does not fully improve that the content of a silica is the less than 2 sections but it exceeds the 20 sections, since the stability of a drainage system dispersing element tends to fall and it becomes cost high, it is not desirable. Moreover, in the case of Seria, when a drainage system dispersing element is made into the 100 sections, it is desirable to be able to consider as the 0.02 to 5 section and to consider as the 0.05 to 2 section and the further 0.1 to 1 section especially. When the content of Seria exceeds a upper limit under a lower limit, since the same problem as a silica is produced, it is not desirable.

[0013] As a nitrogen atom content surfactant used in this invention For example, chlorination lauryl trimethylammonium, chlorination cetyl trimethylammonium, Stearyl chloride trimethylammonium, chlorination distearyldimethylbenzylammonium, The chlorination dialkyl dimethylannmonium containing the alkyl group of carbon numbers 12-18, Cationic surfactants, such as alkyl imidazoline and a benzalkonium chloride solution; Lauryldimethyl betaine aminoacetate, A stearyl dimethylamino acetic-acid betaine, lauryl dimethylamine oxide, 2-alkyl-N-carboxymethyl-N-hydroxyethyl imidazolinium betaine, A lauric-acid amide propyl betaine, a coconut acid-amide propyl betaine, Amphoteric surface active agents, such as lauryl hydroxy sulfobetaine; the nonionic surfactant of alkyl alkanol amide molds, such as polyoxyethylene alkylamine, palm-kernel-oil fatty-acid diethanolamide, and lauric-acid diethanolamide, etc. can be illustrated. A cationic surfactant and a nonionic surface active agent are desirable, and chlorination lauryl trimethylammonium, polyoxyethylene alkylamine, and especially lauric-acid diethanolamide are [among these] desirable.

[0014] Although the content of the nitrogen atom content surfactant in a drainage system dispersing element is based also on a class, it is desirable to be able to consider as the 0.0001 to 1 section, when it considers as the water dispersing element 100 section, and to consider as the 0.001 to 0.1 section still more preferably. If the content of a nitrogen atom content surfactant cannot attain the target flattening in the less than 0.0001 sections but a content exceeds the one section, since a polish rate may fall remarkably, it is not desirable.

[0015] As a medium of a drainage system dispersing element, although the mixed medium which uses water and water, and water, such as a methanol, as a principal component can be used, it is desirable to use only water.

[0016] Various additives can be blended with the drainage system dispersing element of this invention, and the engine performance can be raised further. By making an acid contain, a drainage system dispersing element can be stabilized and selectivity may be raised. Especially this acid is not limited but can use both an organic acid and an inorganic acid. As an organic acid, Para toluenesulfonic acid, dodecylbenzenesulfonic acid, an isoprene sulfonic acid, a gluconic acid, a lactic acid, a citric acid, a tartaric acid, a malic acid, a glycolic acid, a malonic acid, a formic acid, oxalic acid, a succinic acid, a fumaric acid, a maleic acid, a phthalic acid, etc. are mentioned. Moreover, as an inorganic acid, a nitric acid, a hydrochloric acid, a sulfuric acid, etc. are mentioned. These organic acids and an inorganic acid may use only one sort respectively, can also use two or more sorts together, and can also use an organic acid and an inorganic acid together. When a drainage system dispersing element is made into the 100 sections, 0.05-1 section content of these acids can be carried out especially the 0.02 to 2 section.

[0017] The dispersibility of a particle, a polish rate, etc. can be raised more by making a drainage system

dispersing element contain a base further, and adjusting pH. Especially this base is not limited but can use both an organic base and an inorganic base. As an organic base, nitrogen content organic compounds, such as ethylenediamine and ethanolamine, etc. are mentioned. Furthermore, as an inorganic base, ammonia, a potassium hydroxide, a sodium hydroxide, a lithium hydroxide, etc. are mentioned, and these salts may use only one sort and can also use two or more sorts together. The content of a base is important when adjusting pH, but when a drainage system dispersing element is made into the 100 sections, 0.02-0.5 section content can be carried out especially the 0.01 to 1 section.
[0018] Desirable pH changes with inorganic particles, and it is desirable that it is pH 5-12 in the case of 10-12, and Seria, and pH is desirable in the case of a silica, in order for whenever [polish rate and flattening / both] to improve, if it is this pH range.
[0019] A drainage system dispersing element can also be made to contain polyvalent metal ion, such as oxidizing agents, such as a hydrogen peroxide, persulfate, and a heteropolyacid, or aluminum, titanium, vanadium, chromium, and iron, etc. as other additives. Furthermore, viscosity controlling agents, such as dispersants, such as polyacrylic acid of surfactants, such as the dodecylbenzenesulfonic acid potassium and a dodecyl ammonium sulfate, and the amount of macromolecules, and polyacrylamide, etc. can also be made to contain.
[0020] by make various kinds of above-mentioned additives combine and contain an inorganic particle , and if needed [a nitrogen atom content surfactant and if needed] as mentioned above , the chemical machinery polish water system dispersing element of this invention can be use in the STI process in manufacture of a semiconductor device , and generating can make it the abrasive material which be excellent in a flattening engine performance with few [there be little superfluous polish (dishing) of an insulator film and] scratches (blemish of the insulator material list side after polish) .
[0021] When carrying out chemical machinery polish of the polished surface-ed using the chemical machinery polish water-system dispersing element of this invention commercial chemical machinery polish equipment (Ebara Make and a type "EPO-112" --) Lap master SFT company make, such as "EPO-222", a type "LGP-510", Applied material company make, such as "LGP-552", "name-of-article Mirra" ram research company make, a name of article "Teres", Speed It can grind using the product made from Fam-IPEC, a type "AVANTI 472", etc. Although the object can respond and polish conditions can adopt proper conditions, they can be made into the following conditions, for example. drainage system dispersing element amount-of-supply; -- a part for 100 - 300mL/-- polish load; -- 200 - 600 g/cm2 rotating speed; -- 50 - 100rpm head rotational frequency; -- 50 - 100rpm [0022] When the chemical machinery polish water-system dispersing element of this invention contains a silica as an inorganic particle, the dishing T when carrying out the exaggerated polish of the ground body whose initial level difference T0 when only thickness t makes an insulator ingredient deposit on the silicon substrate which formed the slot with a width of face [like drawing 1] of 250 micrometers in the STI process is 400nm or more, for example, 900nm, 15% to the condition of drawing 2 is 90nm or less. Here, "exaggerated 15% polish" means continuing excessive time amount polish only 15% to the polish time amount of JASUTO which **(ed) deposition thickness t of an insulator ingredient at the polish rate.
[0023] Moreover, the dishing T when the same conditions as the above estimate the chemical machinery polish water-system dispersing element of this invention which contains Seria as an inorganic particle is 80nm or less, and can also be set to 70nm or less and 60nm or less by adjusting the amount of the nitrogen atom content surfactant used further. In addition, when the same conditions as the above estimate using the chemical machinery polish water-system dispersing element known conventionally, the value of Dishing T is about 100-200nm.
[0024] The chemical machinery polish water-system dispersing element of this invention has that a scratch occurs [little] in the insulator material-list side after polish, for example, generating of the scratch with a length between couplings of 1 micrometers or more when grinding the thermal oxidation film wafer which is 8 inches for 2 minutes can make it five or less per wafer, and can also make it three or less pieces and zero piece by adjusting the amount of the nitrogen atom content surfactant used further.

[0025]
[Embodiment of the Invention] Below, an example explains this invention in more detail.
[0026] Chlorination lauryl trimethylammonium was blended with the water dispersing element blended so that it might become 10 mass % about the preparation fumed ** silica (the product made from Japanese Aerosil, a trade name "#90 Aerosil", first [an average of] particle size of 20nm, second [an average of] particle size of 220nm) of the drainage system dispersing element example 1** drainage system dispersing element which contains a silica as an inorganic particle and might become the content of 0.2 mass % about KOH 0.001% of the weight as a nitrogen atom content surface active agent, and the drainage system dispersing element was prepared. pH at this time was 10.4.
[0027] ** with [with the assessment TEOS film of dishing] a pattern -- wafer SKW-7 (a trade name, the product made from SKW, line width of face of 250 micrometers, the laminating thickness of 2000nm of an insulator ingredient, initial level difference of 900nm) was ground on the following conditions.
Chemical machinery polish equipment; EPO112 (Ebara Make)
Scouring pad; IC1000/SUBA400 (Rodel Nitta CO. make)
drainage system dispersing element amount-of-supply; -- a part for 200mL/-- polish load; -- 400 g/cm2 rotating speed; -- 70rpm head engine-speed; -- 70rpm polish time amount; -- 15% over (the laminating thickness / polish rate of an insulator ingredient) (x1.15)
[0028] Dishing after polish was measured using the detailed configuration measuring device (the product made from KLA-Tencor, format "P-10"). As a result, dishing was 60nm and was very good. In addition, the valuation basis of the value of dishing is as follows.
70nm or less of; 90nm [of 100nm or more; defects] or less fitness; it is fitness [0029] very much. ** After setting polish time amount as for 2 minutes and also grinding the assessment thermal oxidation film wafer of 8 inches of a scratch (make made from AMT) on the same conditions as **, it measured with pattern-less wafer surface dust-particle-inspection equipment (KEERUE ten call company make, type "the surfboard scan 6420"). Consequently, the scratch was not detected at all.
[0030] The above-mentioned assessment result showed that this drainage system dispersing element was a drainage system dispersing element which has the engine performance very good as a drainage system dispersing element used for a STI process.
[0031] The class of one to examples 2-7 and example of comparison 4 silica, the class of nitrogen atom content surface active agent, and the class of other additives were carried out as shown in a table 1, and assessment of dishing and a scratch was carried out like the example 1. A result is shown in a table 1. In addition, colloidal silica is J.of. Colloid and Interface Science After carrying out condensation of the tetra-ethoxy silane to the bottom of ammonia catalyst existence through ethanol and water as indicated by 25 and 62-69 (1968), what carried out the solvent permutation was used for water. Here, two kinds of colloidal silica, the first [an average of] particle size of 15nm (second [an average of] particle size of 39nm) and the first [an average of] particle size of 35nm (second [an average of] particle size of 67nm), was prepared by adjusting the presentation ratio of ethanol and water. . Moreover, in a table 1, "DBS-K" added as an additive expresses the dodecylbenzenesulfonic acid potassium, and "PAA-K" expresses polyacrylic acid potassium salt (molecular weight; 6000).
[0032]
[A table 1]

	無機粒子		窒素原子含有界面活性剤		その他添加剤	pH調整剤	pH	研磨速度	ディッシング	スクラッチ
	種類	濃度(%)	種類	濃度(%)	種類：濃度	種類：濃度		(nm/min)	(nm)	(個/ウェハ)
実施例1	#80フュームド 20nm	10	塩化ラウリルトリメチルアンモニウム	0.001	—	KOH：0.2%	10.4	180	60	0
実施例2	#90フュームド 20nm	10	塩化ラウリルトリメチルアンモニウム	0.01	—	KOH：0.2%	10.4	120	40	0
実施例3	#90フュームド 20nm	10	ポリオキシエチレンアルキルアミン	0.001	—	KOH：0.2%	10.5	201	65	0
実施例4	#80フュームド 20nm	10	ポリオキシエチレンアルキルアミン	0.01	—	KOH：0.2%	10.6	153	43	0
実施例5	コロイダルシリカ 35nm	12	塩化ラウリルトリメチルアンモニウム	0.001	—	KOH：0.2%	10.2	143	54	0
実施例6	コロイダルシリカ 35nm	12	ポリオキシエチレンアルキルアミン	0.001	—	KOH：0.2%	10.8	163	62	0
実施例7	コロイダルシリカ 15nm	12	ラウリル酸ジエタノールアミド	0.01	—	KOH：0.2%	10.8	181	43	0
比較例1	#90フュームド 20nm	10	無添加	0	—	KOH：0.2%	10.7	210	159	3
比較例2	#90フュームド 20nm	10	無添加	0	DBS-K:0.1%	KOH：0.2%	10.5	54	85	5
比較例3	#90フュームド 20nm	10	無添加	0	PAA-K:0.1%	KOH：0.2%	10.5	29	81	10
比較例4	コロイダルシリカ 35nm	12	無添加	0	—	KOH：0.2%	10.4	185	152	1

[0033] According to the table 1, in the examples 1-7, while the polish rate is as enough as the above by 120nm/, it is 70nm or less, a scratch is not detected at all, either, but dishing understands that these drainage system dispersing elements are very superior as a drainage system dispersing element in a STI process. On the other hand, in the examples 1 and 4 of a comparison, the value of dishing is as large as 115 and 122, and such a drainage system dispersing element cannot be used as a drainage system dispersing element in a STI process. Moreover, in the examples 2 and 3 of a comparison, a polish rate is small and it turns out that these drainage system dispersing elements are those with which practical use cannot be presented.

[0034] After using as the raw material preparation bastnaesite of drainage system dispersing element example 8** Seria which contains Seria as an inorganic particle and dissolving this in a nitric acid, the carbonate of the cerium which repeated recrystallization 3 times as a carbonate and was high-grade-ized was obtained. This was calcinated at 900 degrees C for 5 hours, and Seria was obtained. This Seria was distributed so that it might become ion exchange water with the content of 0.3 mass % under existence

of a nitric acid, pH was adjusted to 6, and the water dispersing element containing Seria with a mean particle diameter (diameter of an aggregated particle) of 0.24 micrometers was obtained. Subsequently, polyoxy SHICHIREN alkylamine was added by the concentration used as 0.03 % of the weight, and the drainage system dispersing element containing Seria was prepared.

[0035] ** The drainage system dispersing element prepared by the assessment above of dishing was used, and dishing was evaluated like the example 1. As a result, dishing was very as good as 60nm.

[0036] ** The drainage system dispersing element prepared by the assessment above of a scratch was used, and the scratch was evaluated like the example 1. Consequently, the scratch was not detected.

[0037] The above-mentioned assessment result showed that this drainage system dispersing element was a drainage system dispersing element which has the engine performance very good as a drainage system dispersing element used for a STI process.

[0038] The class of examples 9-16 and the example 5 of a comparison - 10 nitrogen atom content surfactant, the class of additive of an addition and others, and the addition were carried out as shown in a table 2, and also assessment of dishing and a scratch was carried out like the example 8. A result is shown in a table 2. In addition, DBS-K of the additive of others in a table 2 and PAA-K are the same as a table 1, and "IPS-K" expresses polyisoprene sulfonic-acid potassium salt (molecular weight; 8000).

[0039]

[A table 2]

	無機粒子		窒素原子含有界面活性剤		その他添加剤	pH調整剤	pH	研磨速度	ディッシング	スクラッチ
	種類	濃度(%)	種類	濃度(%)	種類；濃度	種類；濃度		(nm/min)	(nm)	(個/ウェハ)
実施例8	0.24μm酸化セリウム	0.3	ポリオキシエチレンアルキルアミン	0.001	—	KOH；0.04%	6.0	290	50	0
実施例9	0.24μm酸化セリウム	0.3	ポリオキシエチレンアルキルアミン	0.01	—	KOH；0.04%	6.5	210	30	0
実施例10	0.24μm酸化セリウム	0.3	塩化ラウリルトリメチルアンモニウム	0.001	—	KOH；0.04%	6.0	230	59	0
実施例11	0.24μm酸化セリウム	0.3	塩化ラウリルトリメチルアンモニウム	0.01	—	KOH；0.04%	6.2	181	35	0
実施例12	0.24μm酸化セリウム	0.3	ラウリルジメチルアミノ酢酸ベタイン	0.01	—	KOH；0.04%	6.5	143	55	0
実施例13	0.24μm酸化セリウム	0.3	ポリオキシエチレンアルキルアミン	0.01	—	KOH；0.04%	6.9	163	63	0
実施例14	0.24μm酸化セリウム	0.3	ラウリン酸ジエタノールアミド	0.01	—	KOH；0.04%	7.1	181	49	0
比較例5	0.24μm酸化セリウム	0.3	無添加	0	—	KOH；0.04%	6.0	410	210	12
比較例6	0.24μm酸化セリウム	0.3	無添加	0	DBS K;0.1%	KOH；0.04%	6.5	290	120	6
比較例7	0.24μm酸化セリウム	0.3	無添加	0	PAA-K;0.1%	KOH；0.04%	6.7	94	105	12
比較例8	0.24μm酸化セリウム	0.3	無添加	0	IPS-K;0.1%	KOH；0.04%	6.8	210	115	2

[0040] According to the table 2, in the examples 8-14, while a polish rate is fully as large as the above by 140nm/, dishing is 70nm or less, and a scratch is not observed, either but it understands that these drainage system dispersing elements are very superior as a drainage system dispersing element in a STI process. On the other hand, in the examples 5-8 of a comparison, dishing is as large as 100nm or more, and there are also many scratches, and it understands it are [these drainage system dispersing elements] difficult to use it as an object for STI.

[0041]

[Effect of the Invention] According to this invention, a drainage system dispersing element superfluous polish (dishing) of the insulator film is small, and there is little generating of a scratch (blemish of the insulator material-list side after polish), and very suitable as a chemical machinery polish water-system dispersing element used for a STI process is offered.

[0042]

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention] This invention relates to a chemical machinery polish water-system dispersing element. Furthermore, it is related with the chemical machinery polish water-system dispersing element used for the detailed-ized isolation process in the production process of a semiconductor device in detail.

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PRIOR ART

[Description of the Prior Art] The storage capacity of a memory device is increasing by leaps and bounds with improvement in the degree of integration of a semiconductor device, multilayer-interconnection-izing, etc. This is supported to the advance of detailed-izing of a processing technique. However, even if the memory capacity demanded becomes large every year and it makes full use of techniques, such as multilayer-interconnection-izing, the routing counter which buildup of a chip size is not avoided and memory device manufacture takes with detailed-izing increased, and has caused the cost high of a chip. The technique of chemical machinery polish is introduced into polish of the processed film etc. under such a situation, and attention is attracted. By applying the technique of this chemical machinery polish, manufacture of the high capacity memory device of the fine structure is being attained more efficiently.
[0003] As one of such the techniques, detailed-ized isolation (Shallow Trench Isolation) and the so-called STI technique are examined for the purpose of the further detailed-izing. After this STI technique forms a slot in a silicon substrate, it can deposit an insulator layer ingredient, can remove an excessive insulator layer by chemical machinery polish, and can form more detailed wiring structure as compared with the conventional chemical machinery polish. However, with the chemical machinery polish known conventionally, since it differs in the main object for polish, if the dispersing element for chemical machinery polish used conventionally is used as it is, various problems will arise on a process. Especially, superfluous polish (dishing) of the insulator film became large, and it was easy to generate a scratch (blemish of the insulator material-list side after polish), and had become a failure to improvement in the yield of semi-conductor manufacture.

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EFFECT OF THE INVENTION

[Effect of the Invention] According to this invention, a drainage system dispersing element superfluous polish (dishing) of the insulator film is small, and there is little generating of a scratch (blemish of the insulator material-list side after polish), and very suitable as a chemical machinery polish water-system dispersing element used for a STI process is offered.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] This invention aims at superfluous polish (dishing) of the insulator film being small, and there being little generating of a scratch (blemish of the insulator material-list side after polish), namely, offering the chemical machinery polish water-system dispersing element which was excellent in the flattening property and which is used for a STI process in view of the above-mentioned situation.

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MEANS

[Means for Solving the Problem] According to this invention, the above-mentioned technical problem is solved by an inorganic particle and the chemical machinery polish water-system dispersing element characterized by containing a nitrogen atom content surfactant. The chemical machinery polish water-system dispersing element of this invention is explained below at a detail. The chemical machinery polish water-system dispersing element of this invention is an inorganic particle and [0006] containing a nitrogen atom content surfactant. Although a proper thing can be used as the above "an inorganic particle" according to the object, a silica, Seria, an alumina, a titania, a zirconia, etc. are mentioned as a desirable thing, for example. A silica and especially Seria are [among these] desirable. The colloidal silica pass hydrolysis and condensation from the fumed ** silica which ** silicon chloride etc. is made to react to the bottom of existence of hydrogen and oxygen in a gaseous phase as a silica, and is obtained, the colloidal silica obtained by carrying out the ion exchange of the ** silicate, and ** metal alkoxide is mentioned. Moreover, as Seria, the thing which comes to calcinate a carbonic acid cerium, a hydroxylation cerium, or a cerium oxalate can be used, and especially Seria that calcinates a carbonic acid cerium and is obtained is [among these] desirable. Although an inorganic particle may use only one sort, a silica, Seria and a silica, an alumina, Seria, an alumina, etc. can also be used combining two or more sorts. Moreover, an organic particle can also be used combining the above-mentioned inorganic particle.
[0007] As the above "an organic particle", thermoplastics, such as acrylic resin (meta), such as polyolefines, such as a polyvinyl chloride, polystyrene and a styrene system copolymer, polyacetal, saturated polyester, a polyamide, a polycarbonate, polyethylene, polypropylene, poly1 butene, and poly4 methyl 1 pentene, and an olefin system copolymer, phenoxy resin, and polymethylmethacrylate, and (meta) an acrylic copolymer, is mentioned.
[0008] Moreover, the copolymerization resin which has the structure of cross linkage which is made to carry out copolymerization of styrene, methyl methacrylate, etc. a divinylbenzene, ethylene glycol dimethacrylate, etc., and is obtained is mentioned. Furthermore, thermosetting resin, such as phenol resin, a urea-resin, melamine resin, an epoxy resin, an alkyd resin, and an unsaturated polyester resin, is mentioned. These organic particles can be manufactured by various kinds of approaches, such as an emulsion-polymerization method, a suspension-polymerization method, an emulsification variational method, and the grinding method. In addition, an activity is sufficient as these organic particles only in one sort, and they can also use two or more sorts together.
[0009] Furthermore, after each has become independent, it is not necessarily necessary to distribute the inorganic particle and the organic particle. For example, the polycondensation of the alkoxysilane may be carried out in the condition that an inorganic particle and an organic particle are intermingled, and you may be the gestalt of an organic particle with which the polysiloxane etc. was combined with the front face at least, and inorganic particles, such as a silica and Seria, were further combined by electrostatic force etc. In addition, direct coupling of the polysiloxane to generate may be carried out to the anion radical which an organic particle has, and it may be indirectly combined through the silane coupling agent etc.

[0010] That it is 0.01-3 micrometers cannot make mean particle diameter (second [an average of] particle size) of an inorganic particle a drainage system dispersing element with a fully large polish rate to it being desirable and this mean particle diameter being less than 0.01 micrometers. It is not easy for an inorganic particle to sediment, to become easy to dissociate and to consider as a stable drainage system dispersing element on the other hand, when mean particle diameter exceeds 3 micrometers. As for especially this mean particle diameter, it is desirable that they are 0.02-1.0 micrometers and further 0.03-0.7 micrometers. If it is the inorganic particle which has the mean particle diameter of this range, it is large, and sedimentation of a particle and separation are also suppressed, and a polish rate can consider as a stable chemical machinery polish water-system dispersing element. In addition, this mean particle diameter can be measured with a dynamic-light-scattering measurement machine, a laser dispersion diffraction mold measurement machine, etc., and can also be measured by observation by the transmission electron microscope. Moreover, it can dry, the specific surface area of the fine-particles-ized inorganic particle can be measured, and it can also compute based on it.

[0011] As for the mean particle diameter of an organic particle, it is desirable that it is 0.01-3 micrometers. If this mean particle diameter is less than 0.01 micrometers, the ratio to the rate which grinds the silicon nitride film of the rate which grinds the silicon oxide film may be small, and selectivity may not fully improve. It is not easy for an organic particle to sediment, to be easy to dissociate and to consider as a stable drainage system dispersing element on the other hand, when mean particle diameter exceeds 3 micrometers. As for especially this mean particle diameter, it is desirable that they are 0.02-1.0 micrometers and further 0.04-0.7 micrometers. If it is the organic particle which has the mean particle diameter of this range, it excels in a flattening property, and since a hard sedimentation layer is not made even if a particle sediments, it excels in redispersible, and can consider as a stable chemical machinery.polish water-system dispersing element. In addition, this mean particle diameter can be measured like the case of an inorganic particle.

[0012] Although the content of the inorganic particle in a drainage system dispersing element is based also on the class of inorganic particle, when a drainage system dispersing element is made into the 100 mass sections (it is hereafter written as the "section".), in the case of a silica, it is desirable to be able to consider as the two to 20 section and to consider as the four to 15 section and the further six to 12 section especially. When a polish rate does not fully improve that the content of a silica is the less than 2 sections but it exceeds the 20 sections, since the stability of a drainage system dispersing element tends to fall and it becomes cost high, it is not desirable. Moreover, in the case of Seria, when a drainage system dispersing element is made into the 100 sections, it is desirable to be able to consider as the 0.02 to 5 section and to consider as the 0.05 to 2 section and the further 0.1 to 1 section especially. When the content of Seria exceeds a upper limit under a lower limit, since the same problem as a silica is produced, it is not desirable.

[0013] As a nitrogen atom content surfactant used in this invention For example, chlorination lauryl trimethylammonium, chlorination cetyl trimethylammonium, Stearyl chloride trimethylammonium, chlorination distearyldimethylbenzylammonium, The chlorination dialkyl dimethylannmonium containing the alkyl group of carbon numbers 12-18, Cationic surfactants, such as alkyl imidazoline and a benzalkonium chloride solution; Lauryldimethyl betaine aminoacetate, A stearyl dimethylamino acetic-acid betaine, lauryl dimethylamine oxide, 2-alkyl-N-carboxymethyl-N-hydroxyethyl imidazolinium betaine, A lauric-acid amide propyl betaine, a coconut acid-amide propyl betaine, Amphoteric surface active agents, such as lauryl hydroxy sulfobetaine; the nonionic surfactant of alkyl alkanol amide molds, such as polyoxyethylene alkylamine, palm-kernel-oil fatty-acid diethanolamide, and lauric-acid diethanolamide, etc. can be illustrated. A cationic surfactant and a nonionic surface active agent are desirable, and chlorination lauryl trimethylammonium, polyoxyethylene alkylamine, and especially lauric-acid diethanolamide are [among these] desirable.

[0014] Although the content of the nitrogen atom content surfactant in a drainage system dispersing element is based also on a class, it is desirable to be able to consider as the 0.0001 to 1 section, when it considers as the water dispersing element 100 section, and to consider as the 0.001 to 0.1 section still more preferably. If the content of a nitrogen atom content surfactant cannot attain the target flattening in

the less than 0.0001 sections but a content exceeds the one section, since a polish rate may fall remarkably, it is not desirable.
[0015] As a medium of a drainage system dispersing element, although the mixed medium which uses water and water, and water, such as a methanol, as a principal component can be used, it is desirable to use only water.
[0016] Various additives can be blended with the drainage system dispersing element of this invention, and the engine performance can be raised further. By making an acid contain, a drainage system dispersing element can be stabilized and selectivity may be raised. Especially this acid is not limited but can use both an organic acid and an inorganic acid. As an organic acid, Para toluenesulfonic acid, dodecylbenzenesulfonic acid, an isoprene sulfonic acid, a gluconic acid, a lactic acid, a citric acid, a tartaric acid, a malic acid, a glycolic acid, a malonic acid, a formic acid, oxalic acid, a succinic acid, a fumaric acid, a maleic acid, a phthalic acid, etc. are mentioned. Moreover, as an inorganic acid, a nitric acid, a hydrochloric acid, a sulfuric acid, etc. are mentioned. These organic acids and an inorganic acid may use only one sort respectively, can also use two or more sorts together, and can also use an organic acid and an inorganic acid together. When a drainage system dispersing element is made into the 100 sections, 0.05-1 section content of these acids can be carried out especially the 0.02 to 2 section.
[0017] The dispersibility of a particle, a polish rate, etc. can be raised more by making a drainage system dispersing element contain a base further, and adjusting pH. Especially this base is not limited but can use both an organic base and an inorganic base. As an organic base, nitrogen content organic compounds, such as ethylenediamine and ethanolamine, etc. are mentioned. Furthermore, as an inorganic base, ammonia, a potassium hydroxide, a sodium hydroxide, a lithium hydroxide, etc. are mentioned, and these salts may use only one sort and can also use two or more sorts together. The content of a base is important when adjusting pH, but when a drainage system dispersing element is made into the 100 sections, 0.02-0.5 section content can be carried out especially the 0.01 to 1 section.
[0018] Desirable pH changes with inorganic particles, and it is desirable that it is pH 5-12 in the case of 10-12, and Seria, and pH is desirable in the case of a silica, in order for whenever [polish rate and flattening / both] to improve, if it is this pH range.
[0019] A drainage system dispersing element can also be made to contain polyvalent metal ion, such as oxidizing agents, such as a hydrogen peroxide, persulfate, and a heteropolyacid, or aluminum, titanium, vanadium, chromium, and iron, etc. as other additives. Furthermore, viscosity controlling agents, such as dispersants, such as polyacrylic acid of surfactants, such as the dodecylbenzenesulfonic acid potassium and a dodecyl ammonium sulfate, and the amount of macromolecules, and polyacrylamide, etc. can also be made to contain.
[0020] by make various kinds of above-mentioned additives combine and contain an inorganic particle , and if needed [a nitrogen atom content surfactant and if needed] as mentioned above , the chemical machinery polish water system dispersing element of this invention can be use in the STI process in manufacture of a semiconductor device , and generating can make it the abrasive material which be excellent in a flattening engine performance with few [there be little superfluous polish (dishing) of an insulator film and] scratches (blemish of the insulator material list side after polish) .
[0021] When carrying out chemical machinery polish of the polished surface-ed using the chemical machinery polish water-system dispersing element of this invention commercial chemical machinery polish equipment (Ebara Make and a type "EPO-112" --) Lap master SFT company make, such as "EPO-222", a type "LGP-510", Applied material company make, such as "LGP-552", "name-of-article Mirra" ram research company make, a name of article "Teres", Speed It can grind using the product made from Fam-IPEC, a type "AVANTI 472", etc. Although the object can respond and polish conditions can adopt proper conditions, they can be made into the following conditions, for example. drainage system dispersing element amount-of-supply; -- a part for 100 - 300mL/-- polish load; -- 200 - 600 g/cm2 rotating speed; -- 50 - 100rpm head rotational frequency; -- 50 - 100rpm [0022] When the chemical machinery polish water-system dispersing element of this invention contains a silica as an inorganic particle, the dishing T when carrying out the exaggerated polish of the ground body whose initial level difference T0 when only thickness t makes an insulator ingredient deposit on the silicon

substrate which formed the slot with a width of face [like drawing 1] of 250 micrometers in the STI process is 400nm or more, for example, 900nm, 15% to the condition of drawing 2 is 90nm or less. Here, "exaggerated 15% polish" means continuing excessive time amount polish only 15% to the polish time amount of JASUTO which **(ed) deposition thickness t of an insulator ingredient at the polish rate.

[0023] Moreover, the dishing T when the same conditions as the above estimate the chemical machinery polish water-system dispersing element of this invention which contains Seria as an inorganic particle is 80nm or less, and can also be set to 70nm or less and 60nm or less by adjusting the amount of the nitrogen atom content surfactant used further. In addition, when the same conditions as the above estimate using the chemical machinery polish water-system dispersing element known conventionally, the value of Dishing T is about 100-200nm.

[0024] The chemical machinery polish water-system dispersing element of this invention has that a scratch occurs [little] in the insulator material-list side after polish, for example, generating of the scratch with a length between couplings of 1 micrometers or more when grinding the thermal oxidation film wafer which is 8 inches for 2 minutes can make it five or less per wafer, and can also make it three or less pieces and zero piece by adjusting the amount of the nitrogen atom content surfactant used further.

[0025]

[Embodiment of the Invention] Below, an example explains this invention in more detail.

[0026] Chlorination lauryl trimethylammonium was blended with the water dispersing element blended so that it might become 10 mass % about the preparation fumed ** silica (the product made from Japanese Aerosil, a trade name "#90 Aerosil", first [an average of] particle size of 20nm, second [an average of] particle size of 220nm) of the drainage system dispersing element example 1** drainage system dispersing element which contains a silica as an inorganic particle and might become the content of 0.2 mass % about KOH 0.001% of the weight as a nitrogen atom content surface active agent, and the drainage system dispersing element was prepared. pH at this time was 10.4.

[0027] ** with [with the assessment TEOS film of dishing] a pattern -- wafer SKW-7 (a trade name, the product made from SKW, line width of face of 250 micrometers, the laminating thickness of 2000nm of an insulator ingredient, initial level difference of 900nm) was ground on the following conditions.

Chemical machinery polish equipment; EPO112 (Ebara Make)
Scouring pad; IC1000/SUBA400 (Rodel Nitta CO. make)
drainage system dispersing element amount-of-supply; -- a part for 200mL/-- polish load; -- 400 g/cm2 rotating speed; -- 70rpm head engine-speed; -- 70rpm polish time amount; -- 15% over (the laminating thickness / polish rate of an insulator ingredient) (x1.15)

[0028] Dishing after polish was measured using the detailed configuration measuring device (the product made from KLA-Tencor, format "P-10"). As a result, dishing was 60nm and was very good. In addition, the valuation basis of the value of dishing is as follows.

70nm or less of; 90nm [of 100nm or more; defects] or less fitness; it is fitness [0029] very much. ** After setting polish time amount as for 2 minutes and also grinding the assessment thermal oxidation film wafer of 8 inches of a scratch (make made from AMT) on the same conditions as **, it measured with pattern-less wafer surface dust-particle-inspection equipment (KEERUE ten call company make, type "the surfboard scan 6420"). Consequently, the scratch was not detected at all.

[0030] The above-mentioned assessment result showed that this drainage system dispersing element was a drainage system dispersing element which has the engine performance very good as a drainage system dispersing element used for a STI process.

[0031] The class of one to examples 2-7 and example of comparison 4 silica, the class of nitrogen atom content surface active agent, and the class of other additives were carried out as shown in a table 1, and assessment of dishing and a scratch was carried out like the example 1. A result is shown in a table 1. In addition, colloidal silica is J.of. Colloid and Interface Science After carrying out condensation of the tetra-ethoxy silane to the bottom of ammonia catalyst existence through ethanol and water as indicated

by 25 and 62-69 (1968), what carried out the solvent permutation was used for water. Here, two kinds of colloidal silica, the first [an average of] particle size of 15nm (second [an average of] particle size of 39nm) and the first [an average of] particle size of 35nm (second [an average of] particle size of 67nm), was prepared by adjusting the presentation ratio of ethanol and water. . Moreover, in a table 1, "DBS-K" added as an additive expresses the dodecylbenzenesulfonic acid potassium, and "PAA-K" expresses polyacrylic acid potassium salt (molecular weight; 6000).

[0032]

[A table 1]

	無機粒子		窒素原子含有界面活性剤		その他添加剤		pH調整剤	pH	研磨速度	ディッシング	スクラッチ
	種類	濃度(%)	種類	濃度(%)	種類：濃度		種類：濃度		(nm/min)	(nm)	(個/ウェハ)
実施例1	#90フュームド 20nm	10	塩化ラウリルトリメチルアンモニウム	0.001	—		KOH：0.2%	10.4	180	60	0
実施例2	#90フュームド 20nm	10	塩化ラウリルトリメチルアンモニウム	0.01	—		KOH：0.2%	10.4	120	40	0
実施例3	#90フュームド 20nm	10	ポリオキシエチレンアルキルアミン	0.001	—		KOH：0.2%	10.5	201	65	0
実施例4	#90フュームド 20nm	10	ポリオキシエチレンアルキルアミン	0.01	—		KOH：0.2%	10.6	153	43	0
実施例5	コロイダルシリカ 35nm	12	塩化ラウリルトリメチルアンモニウム	0.001	—		KOH：0.2%	10.2	143	54	0
実施例6	コロイダルシリカ 35nm	12	ポリオキシエチレンアルキルアミン	0.001	—		KOH：0.2%	10.8	163	62	0
実施例7	コロイダルシリカ 15nm	12	ラウリン酸ジエタノールアミド	0.01	—		KOH：0.2%	10.8	181	43	0
比較例1	#90フュームド 20nm	10	無添加	0	—		KOH：0.2%	10.7	210	159	3
比較例2	#90フュームド 20nm	10	無添加	0	DBS-K:0.1%		KOH：0.2%	10.5	54	85	5
比較例3	#90フュームド 20nm	10	無添加	0	PAA-K:0.1%		KOH：0.2%	10.5	29	81	10
比較例4	コロイダルシリカ 35nm	12	無添加	0	—		KOH：0.2%	10.4	185	152	1

[0033] According to the table 1, in the examples 1-7, while the polish rate is as enough as the above by 120nm/, it is 70nm or less, a scratch is not detected at all, either, but dishing understands that these drainage system dispersing elements are very superior as a drainage system dispersing element in a STI process. On the other hand, in the examples 1 and 4 of a comparison, the value of dishing is as large as 115 and 122, and such a drainage system dispersing element cannot be used as a drainage system

dispersing element in a STI process. Moreover, in the examples 2 and 3 of a comparison, a polish rate is small and it turns out that these drainage system dispersing elements are those with which practical use cannot be presented.

[0034] After using as the raw material preparation bastnaesite of drainage system dispersing element example 8** Seria which contains Seria as an inorganic particle and dissolving this in a nitric acid, the carbonate of the cerium which repeated recrystallization 3 times as a carbonate and was high-grade-ized was obtained. This was calcinated at 900 degrees C for 5 hours, and Seria was obtained. This Seria was distributed so that it might become ion exchange water with the content of 0.3 mass % under existence of a nitric acid, pH was adjusted to 6, and the water dispersing element containing Seria with a mean particle diameter (diameter of an aggregated particle) of 0.24 micrometers was obtained. Subsequently, polyoxy SHICHIREN alkylamine was added by the concentration used as 0.03 % of the weight, and the drainage system dispersing element containing Seria was prepared.

[0035] ** The drainage system dispersing element prepared by the assessment above of dishing was used, and dishing was evaluated like the example 1. As a result, dishing was very as good as 60nm.

[0036] ** The drainage system dispersing element prepared by the assessment above of a scratch was used, and the scratch was evaluated like the example 1. Consequently, the scratch was not detected.

[0037] The above-mentioned assessment result showed that this drainage system dispersing element was a drainage system dispersing element which has the engine performance very good as a drainage system dispersing element used for a STI process.

[0038] The class of examples 9-16 and the example 5 of a comparison - 10 nitrogen atom content surfactant, the class of additive of an addition and others, and the addition were carried out as shown in a table 2, and also assessment of dishing and a scratch was carried out like the example 8. A result is shown in a table 2. In addition, DBS-K of the additive of others in a table 2 and PAA-K are the same as a table 1, and "IPS-K" expresses polyisoprene sulfonic-acid potassium salt (molecular weight; 8000).

[0039]

[A table 2]

	無機粒子		窒素原子含有界面活性剤		その他添加剤	pH調整剤	pH	研磨速度	ディッシング	スクラッチ
	種類	濃度(%)	種類	濃度(%)	種類；濃度	種類；濃度		(nm/min)	(nm)	(個/ウェハ)
実施例8	0.24μm酸化セリウム	0.3	ポリオキシエチレンアルキルアミン	0.001	—	KOH；0.04%	6.0	290	50	0
実施例9	0.24μm酸化セリウム	0.3	ポリオキシエチレンアルキルアミン	0.01	—	KOH；0.04%	6.5	210	30	0
実施例10	0.24μm酸化セリウム	0.3	塩化ラウリルトリメチルアンモニウム	0.001	—	KOH；0.04%	6.0	230	59	0
実施例11	0.24μm酸化セリウム	0.3	塩化ラウリルトリメチルアンモニウム	0.01	—	KOH；0.04%	6.2	181	35	0
実施例12	0.24μm酸化セリウム	0.3	ラウリルジメチルアミノ酢酸ベタイン	0.01	—	KOH；0.04%	6.5	143	55	0
実施例13	0.24μm酸化セリウム	0.3	ポリオキシエチレンアルキルアミン	0.01	—	KOH；0.04%	6.9	163	63	0
実施例14	0.24μm酸化セリウム	0.3	ラウリン酸ジエタノールアミド	0.01	—	KOH；0.04%	7.1	181	49	0
比較例5	0.24μm酸化セリウム	0.3	無添加	0	—	KOH；0.04%	6.0	410	210	12
比較例6	0.24μm酸化セリウム	0.3	無添加	0	DBS K;0.1%	KOH；0.04%	6.5	290	120	6
比較例7	0.24μm酸化セリウム	0.3	無添加	0	PAA-K;0.1%	KOH；0.04%	6.7	94	105	12
比較例8	0.24μm酸化セリウム	0.3	無添加	0	IPS-K;0.1%	KOH；0.04%	6.8	210	115	2

[0040] According to the table 2, in the examples 8-14, while a polish rate is fully as large as the above by 140nm/, dishing is 70nm or less, and a scratch is not observed, either but it understands that these drainage system dispersing elements are very superior as a drainage system dispersing element in a STI process. On the other hand, in the examples 5-8 of a comparison, dishing is as large as 100nm or more, and there are also many scratches, and it understands it are [these drainage system dispersing elements] difficult to use it as an object for STI.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the mimetic diagram showing the condition before polish of the ground object in chemical machinery polish of a STI process.
[Drawing 2] It is the mimetic diagram showing the condition after polish of the ground object in chemical machinery polish of a STI process.
[Description of Notations]
1 Silicon Substrate
2 Insulator Ingredient
t Initial deposition thickness of an insulator ingredient
T0 Initial level difference
T Dishing

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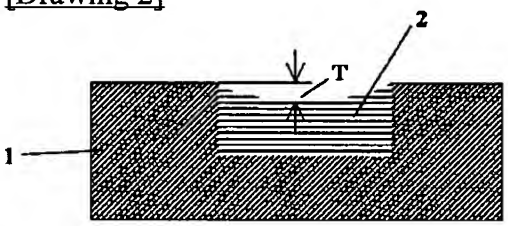
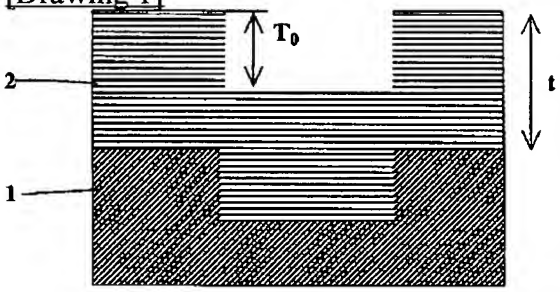
DRAWINGS

[Drawing 2]



[Drawing 1]



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